FAA AVIATION NEWS

OCTOBER 1974

FAA AVIATION NEWS

COVER:
Ill winds and unwary pilots. See page 8

FAA AVIATION NEWS

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The Flight Case Planning Chart

At last! A planning chart you can travel with.

With only the pale light of the bedlamp to work by, you have the phone receiver squeezed between your shoulder and ear and a pencil clutched in your teeth as you shuffle sectionals about on the bed, measure distances with a six-inch ruler, and listen to the weather briefer all at the same time. The Atlanta flight service station has just given you the bad news: the two-hour flight in your little single-engine that you so carefully planned last night—from Atlanta where you have been on business, back to Cincinnati where you have an important appointment at 11 a.m.—is going to be more complicated than you thought. The frontal system that was expected to be well out of the way this morning has bogged down in the Smoky Mountains, and now lies squarely in your flight path. You may still be able to get back in time, but it will require some detouring.

So you struggle with the charts, trying to locate the stations as the briefer recites weather conditions. *"Chattanooga, 800 foot overcast, visibility one and one half miles Knoxville, sky obscured, visibility one-half mile . . . Anniston has 5,000 feet broken—"*

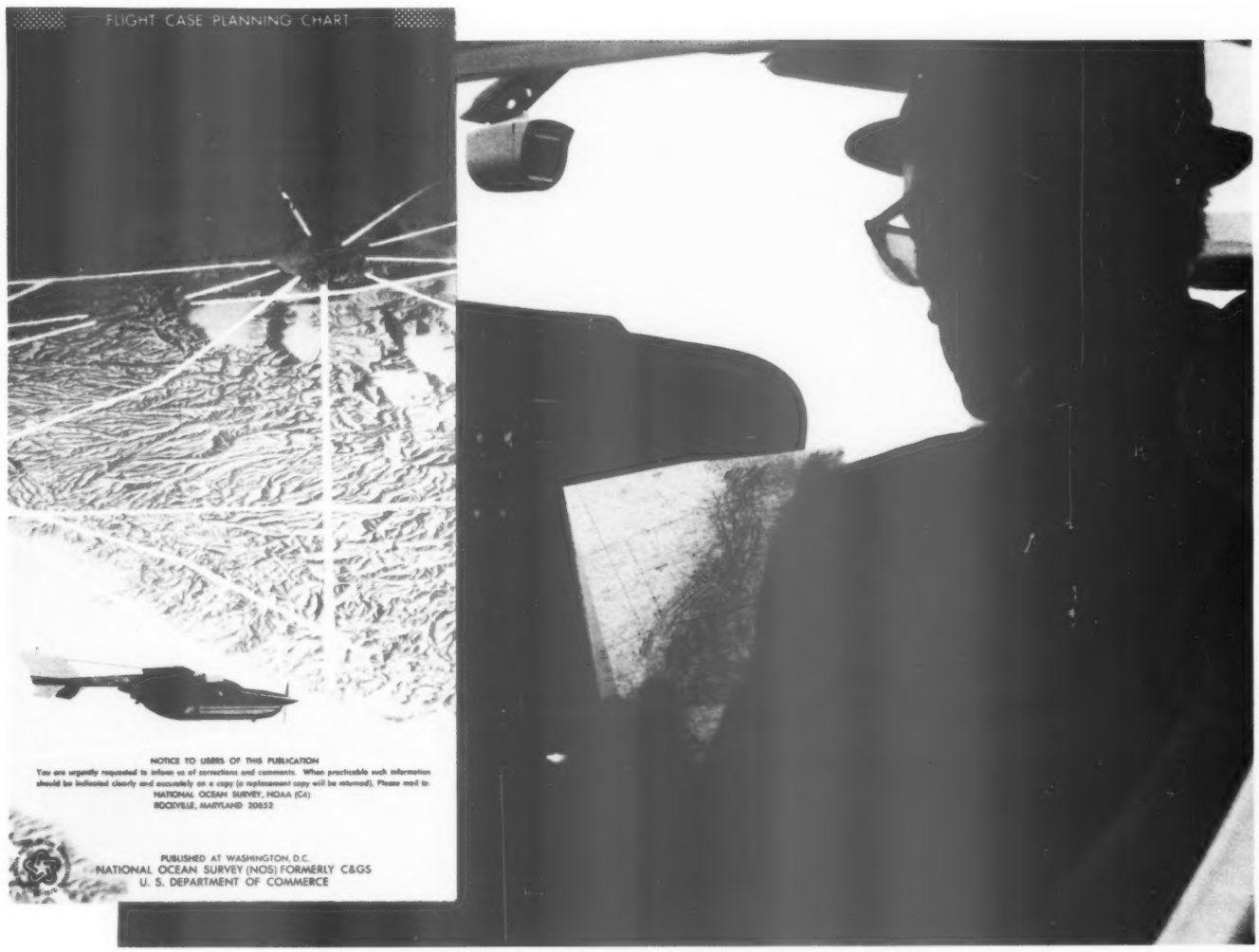
"—Anniston?" you interrupt. "Where is that?"

"About 80 nautical miles west of Atlanta."

After some fruitless searching you flip back to the southern half of your Atlanta sectional and locate Anniston FSS. *Aha!* "What have you got north of Anniston?" you ask. You learn that north of Anniston, Huntsville looks pretty good and farther up Nashville is even better. Bowling Green and Louisville are both clear, and there you are, home free.

The only problem is that you do not have a St. Louis sectional (which you will need for Bowling Green and Louisville) in your flight bag, so you hope to Heaven you can buy one at the airport. If not—well you don't want to think about it now. *Why don't they make a chart that a private pilot can use for planning that isn't so big it has to be spread out over a mile-wide desk or wall, or else is so small you need a dozen of them to fly anywhere, and X-ray eyes to remember what is on the other side?*

Every chart represents a compromise between the desires and objectives of all its potential users, so the Perfect Chart will always be a dream. Just the same, FAA's Air Traffic Service and its associated chart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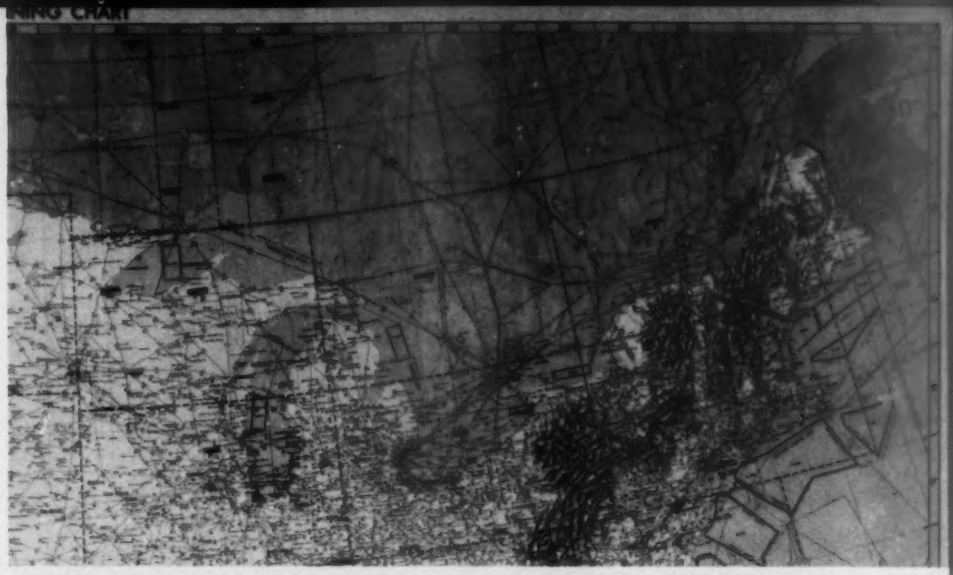
planners have come out with the "Flight Case Planning Chart" which should go a long way toward solving the problems of VFR flight planning at home or en route.

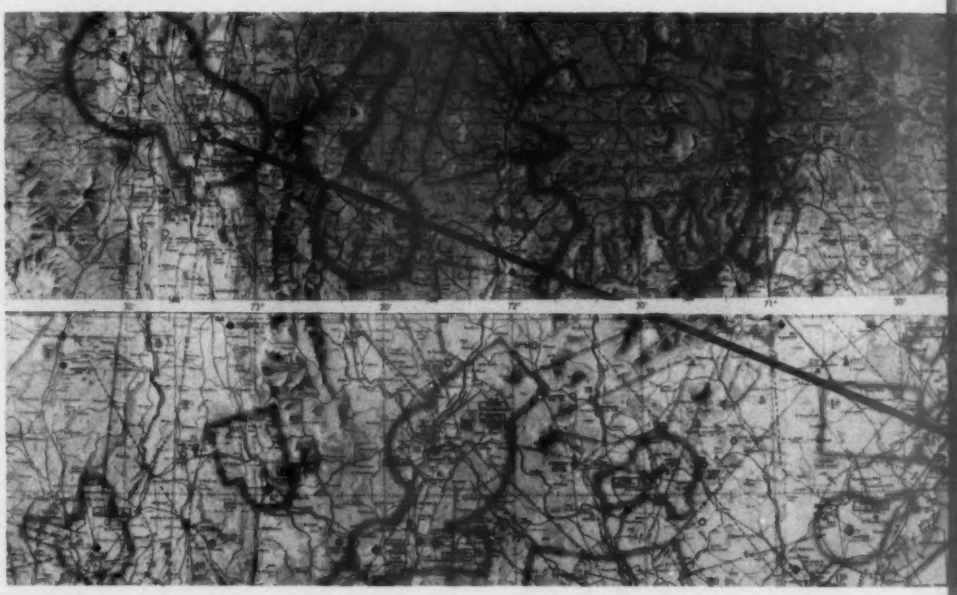
The Flight Case Planning Chart, which covers the adjacent 48 states, can be held up unfolded by a pilot with normal length arms and it has all the basic information you may need for flight planning, including a quick identification of the sectionals you will or might want.

This new chart fills a long standing need for a single planning tool that the visual flyer can use to plot his course before, and during, the flight—something that shows VORs and the distance between them, cities, airports, terrain, restricted areas and miscellaneous other objects that go into decision-making about a flight. And it eliminates the need for carrying a whole armful of papers back to your room or wherever else you might be phoning for weather reports before heading for the airport.

The new chart supplants the old Aeronautical Planning Chart (commonly known as "AP-9") which has been out of production since 1963. Quite a few of these are still seen on walls around the country, despite their obsolete information and nonexistent red- and blue-airways.



Planning chart and sectionals are ideal travelmates. Once you have located your route on the former (above) you can quickly see which navigation charts you need for flight.



WACs or Sectionals

In recent years, pilots anticipating a VFR cross-country flight have had a choice of several make-do solutions to the planning problem. They could use an assemblage of WAC charts (16 miles to an inch) or two-sided sectionals (8 miles to an inch); they could refer to the two huge sheets of the "VFR/IFR Wall Planning Chart"; or they could resort to IFR charts.

Most pilots settle for sectionals. They are familiar, they provide great detail, and they are usually on hand, or easy to get. Although WAC charts are of a more convenient size, they are used to a lesser extent; sectionals show greater detail and are more frequently revised. Using sectionals for planning is fine if your trip does not traverse more than one side of one chart, but most flights of any length will cross over one or two sides of two or more sectional charts, involving yards of paper and planning space. One side of a sectional covers an area about 400 miles by 130 to 160 miles.

If you have a big enough wall or planning table available you could opt for the two-sheet IFR/VFR Wall Planning Chart. The two halves it takes to cover the country together measure 82 x 56 inches—hardly suitable for use in the ordinary cockpit. And although the VFR/IFR chart does have most of the information needed for flight planning, it is necessary to refer to both sides to gather it. Cities, airports and VORs appear on the VFR side, but you must look on the IFR portion to find airways and distances.

Another partial solution has been to use IFR charts for VFR flights. While these charts give comprehensive data on NAVAIDS and distances, they provide only sketchy information about terrain. They are quite inadequate for VFR planning, to say nothing of actually navigating during a flight. A good example of the adage that "a little learning is a dangerous thing" is the VFR pilot who learns to read low altitude en route IFR charts, and is so impressed with their convenience that he decides to use them for cross-country VFR flying instead of sectionals. This in an invitation to disaster. Unless you observe the published "minimum en route altitude" (MEA) for each airway segment you could be surprised by coming face to face with man-made or terrain obstacles. And unless you keep constant track of where you are at all times during your flight (computing "fixes" by cross checking VORs) you might have a hard time finding the nearest landing strip in case of emergency.

IFR charts were designed specifically for IFR flight, on an IFR flight plan, under control of the air traffic system. They were never meant for VFR navigation. Used properly they can serve as a handy supplement to the sectional, but they should *never* be used alone for VFR navigation.

At any rate, the VFR pilot now has available a chart especially designed to meet his planning needs and the name, Flight Case Planning Chart, pretty well describes it. Printed on a single sheet of paper, it folds to a neat five by ten inches, about the same as a folded sectional. Fully open, it is 30 by 50 inches; by unfolding

just two of the accordian folds you can survey an east-west route of about 1,200 miles.

On the face of the chart is a map of the 48 states (and parts of Canada and Mexico), showing cities, airports, airways, VORs and mileage between them, and restricted areas. A limited amount of relief and surface features are shown, those that might affect your planning: mountains, lakes, also restricted areas you might want to circumnavigate in a small aircraft, especially of the single-engine variety.

Smaller terrain details, roads, railways, power lines, streams and other items normally used as VFR pilotage checkpoints, are not included as they are on sectional charts, for two reasons. First, because the scale of one inch to 60 miles makes it impossible to show fine detail, and second, because the Planning Chart was not intended for navigational purposes but rather for *planning*. It is used to best advantage in conjunction with sectional charts. There is also a diagram on the chart that shows low altitude or high altitude en route charts, and also terminal control area charts, where available.

In congested areas, all airports with a 5,000 foot hard surface runway are shown. In non-congested areas, airports with 3,000 foot hard runways are shown.

Airways are shown, as are distances between VORs or VORTACs. Minimum en route altitudes are *not* indicated on the planning chart (as they are on IFR charts); however if the MEA for a given airway segment is above 10,000 feet, the segment is shown in a broader line, designed to signal the VFR pilot that he might need oxygen for that portion of the flight.

The back side of the chart is filled with useful data. There is a list of cities and airports (coded to show instrument airports and also weather stations), a mileage table for more than 170 cities, and a schedule of restricted areas, hours of effectiveness and contacts. The Morse code is listed, as are state abbreviations and three-letter idents of air traffic control centers.

Pilots who are using the new planning chart for the first time are urged to study the legend carefully to find out just what information is provided on the chart. Symbols will help you quickly determine such things as:

- Which cities are listed on the mileage table on the flip side of the chart (these cities are printed in green, other cities are in black and airports are in red).
- Which cities have terminal control area charts (these are printed and underlined in green).
- Which locations have flight service stations on the airports (airport name is underlined in red).
- Locations of VORs ⊙ and VORTACs ⊙ (Latter supply DME data)
- Highest terrain within a sectional boundary (indicated by numbe ; beneath the section name. For example, 8⁹, which appears beneath "WICHITA" means highest terrain on that sectional chart is 8,900 feet).
- Time zones.
- ADIZ boundaries. (Penetrating this zone requires DVFR flight plan.)
- Segments of airways requiring 10,000 altitude, and probable oxygen (indicated by wider airway line).

The Flight Case Chart will enable you to pick out your route, and check your mileage, list your checkpoints and the distances between them, identify the highest altitudes you will need to fly, find out what time zones you will traverse, learn where you can get weather information along the way, and determine what charts you will need.

Planning With Ease

The convenience of the new charts for flight planning purposes can be illustrated by "re-living" the daybreak drama in the Atlanta hotel room with which this article began. With only two folds of the Planning Chart open, the no longer harried pilot could see both the previous planned route and the alternate that was programmed after the 6 a.m. weather reports. With just a little bit of arithmetic he could estimate the added distance and time—45 minutes extra, but a safe flight home, and in time for his morning meeting. In fact, had he used the Planning Chart in making up his original flight plan, chances are he would have noticed that just a small detour to the west would have run him off the Cincinnati chart, and he would probably have brought the next chart along.

There is no doubt that better planning makes for safer flying. A recent analysis of general aviation accidents lists inadequate preflight preparation and planning as the single largest cause, figuring in 17 percent of the accidents. Taking advantage of a better tool for better planning, is a painless way to make yourself a safer pilot.

Don't run off the chart.

One of the attractive features of the new chart is that it is compact enough to use anywhere—a boon to the VFR pilot, who cannot always choose where he replans his flight.

The planning chart, which costs $1.50 and is updated twice yearly, can be purchased from fixed base operators at most airports, or ordered by mail from Distribution Division (C-44), National Ocean Survey, Riverdale, Md. 20840.

Users are urged to report any discrepancies or corrections to the chart. When practical, indicate such information directly on the chart and mail to: National Ocean Survey, NOAA (C-4), Rockville, Md. 20852. A replacement copy will be returned if you include your name and address.

FARs

STATUS of the FEDERAL AVIATION REGULATIONS

(As of October 1, 1974)

The Federal Aviation Regulations, formerly published only in volumes, are in the process of being re-issued as individual Parts. The conversion is scheduled for completion in early 1975. Infrequently amended Parts will be sold as a single-sale item, while frequently amended Parts will be sold on subscription. Current subscribers to volumes will be notified of prices and ordering procedure for the new Parts.

Number in parenthesis after each Part indicates the latest transmittal or change, if any, to that Part. FAR's may be purchased from any Government Printing Office Bookstore or from the Superintendent of Documents Washington, D.C. 20402.

FAA SEPARATE PARTS	TITLE	PRICE
Parts sold by subscription		+ foreign mailing
Part 1	Definitions and Abbreviations	$3.00 + 75¢
Part 21	Certification Procedures for Products and Parts	$3.75 + 95¢
Part 23	Airworthiness Standards: Normal, Utility and Acrobatic Category Airplanes	$3.55 + 90¢
Part 25	Airworthiness Standards: Transport Category Airplanes	$6.60 + $1.65
Part 33	Airworthiness Standards: Aircraft Engines	$3.00 + 75¢
Part 36	Noise Standards Aircraft Type Certification	$3.00 + 75¢
Part 37	Technical Standard Order Authorizations	$5.65 + $1.45
Part 43	Maintenance, Prevention Maintenance, Rebuilding and Alteration	$2.50 + 65¢
Part 47	Aircraft Registration	$2.50 + 65¢
Part 61	Certification: Pilots and Flight Instructors	$5.05 + $1.30
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*Changes to individual airspace designations and airways descriptions, individual restricted areas and individual jet route descriptions are not included in the basic Parts 71, 73 and 75, respectively, because of their length and complexity. Such changes are published in the Federal Register and are included on appropriate aeronautical charts.

**Due to the complexity, length, and frequency of issuance, airworthiness directives, enroute IFR altitudes and standard instrument approach procedures are published in the Federal Register and are not included in basic Parts 39, 95, and 97. In addition, enroute IFR altitudes and instrument approach procedures are depicted on aeronautical charts.

Standard instrument approach procedures are published in the Federal Register by reference to FAA documents which are available for examination at the Rules Docket (AGC-24) and the National Flight Data Center, in FAA Headquarters, Washington, D.C. and at FAA Regional offices and Flight Inspection District Offices.

AIRCRAFT STANDARDS: A New Look

Midpoint report on the program for overhauling airworthiness regulations

What is "sacred" about 100 hours as the maximum period a general aviation aircraft can be used in commerce without an inspection? Should all aircraft be obliged to have and use strobe lights in the interests of avoiding midair collisions? Could small aircraft that stayed below 3,000 feet be exempt from such required equipment as radios, emergency locator transmitters and transponders? Should the installation and use of shoulder harness be mandatory in small airplanes?

These and hundreds of other questions relating to the airworthiness regulations for aircraft certificated in the United States will be debated exhaustively during an eight-day Airworthiness Review Conference sponsored by FAA in Washington, D.C., December 2-11. The meeting which will take place at the Shoreham-Americana Hotel, is open to the public. The registration fee in $25.

The conference represents a mid-stage in the 24-month cycle of FAA's ongoing Airworthiness Review Program, established this year for the purpose of giving the public a voice in a regular biennial overhauling of airworthiness regulations. These regulations establish the standards according to which all aircraft flown in this country must be designed and equipped.

Earlier stages of the program involved the soliciting, from the public and from within FAA, of proposals for changes; a compilation of these proposals; and subsequently, the soliciting of *comments* on the proposals. Of the more than 1,000 proposals in the compilation, approximately 550 came from a variety of outside (non-FAA) sources such as manufacturers and organizations of manufacturers; general aviation groups; operators of aircraft; fixed base operators; pilot organizations, stewardess/steward groups; foreign governments and manufacturers, including the Joint Steering Committee for Joint Airworthiness Requirements (JAR) which is interested in attaining consistency between United States standards and those in Europe. A few proposals came from individuals.

The proposals, which touch on literally hundreds of facets of aircraft airworthiness, have been separated into five categories for discussion by as many committees, They include:

Committee I: *Procedures and Special Issues,* which will include type certification procedures, quality control, import and export certification, balloons, continued airworthiness, etc.

Committee II: *Flight,* which includes performance, flight characteristics, operating limitations and flight manuals for large and small aircraft and rotorcraft.

Committee III: *Airframe* (To work in two parts for [a] large aircraft and [b] small aircraft and rotorcraft). These groups will consider standards for design and construction, control systems, landing gear, pressurization, etc.

Committee IV: *Powerplant,* including fuel, oil and cooling systems, engine controls and instruments, propeller, etc.

Committee V: *Systems and Equipment,* including instruments, automatic pilot, electrical system, lights, hydraulic system, pressurization, ventilation, etc.

About 5,000 comments were received on the compilation of proposals, indicating that many issues remain to be debated during the conference. FAA Flight Standards personnel from headquarters and the field will participate as committee chairmen and spokesmen. The views of all participants will be taken into account in preparing a Notice of Proposed Rulemaking, targetted for publication on May 30, 1975. After the public has had an opportunity to comment on this Notice, the regulatory changes will be drafted in final form. A new round of rule change considerations will begin early the following year.

Authority to establish airworthiness standards in the United States dates back to the Air Commerce Act of 1926, which resulted in the creation of an "Aeronautics Branch" in the Department of Commerce. This authority later was given to an independent agency (the Federal Aviation Agency) which in turn became part of the Department of Transportation in 1966. Over the ensuing half century of Federal responsibility for aircraft airworthiness, an extensive body of regulations has been formulated. However, the state of the art in aviation has changed so rapidly and radically in recent years that it has become increasingly difficult to keep airworthiness standards up to date. With an ongoing Airworthiness Review Program on a biennial cycle, it will now be possible to pinpoint major areas of concern in a timely manner, and to process needed rule changes more effectively.

As a result, aircraft and aircraft components manufacturers both at home and abroad should find themselves better able to live with the regulations governing type certification. The fall-out to pilots will be reduction in costs, in some instances, and an improvement in safety and convenience in others. FAA expects to benefit also in terms in fewer requests for waivers or exemptions from the updated regulations. It is hoped that all persons concerned with the effects of airworthiness regulations upon flying will become familiar with the review program and will participate to the extent possible. ■

Have you ever been flying smoothly along VFR on a clear, dry day with no weather or turbulence forecast, and then suddenly—*wham!*—found yourself being tossed wildly about as though by a gigantic invisible hand?

If so, you know that turbulence is not only related to storm clouds or frontal passage. Clear air turbulence is one of the few obstacles to flight which may not be seen by the naked eye nor can it be forecast with any degree of certainty as to time and place. It goes with the wind In fact, it *is* the wind, in a very bad temper. In the early days of aviation it was at times nervously referred to as "ghosts in the sky."

Here is how one pilot unexpectedly encountered this ghost and then discovered how dangerous it could be for his light air plane. The pilot, 49 years of old and instrument rated, was highly experienced—over 7,000 total hours logged—but he was a retired military flyer, with most of his flying done in heavy jet aircraft. In fact, he had only four hours in the Cessna 140 he was to fly on the day of his accident. And a small single engine airplane, as he was to discover, is much more responsive to the violent tossing of turbulent winds than is a heavier and more powerful airplane.

The flight was a solo from Boise to Idaho Falls, Idaho, a trip of over 200 miles on a clear day in mid-April. Before takeoff the pilot received a weather briefing from his FSS: *VFR conditions, no precipitation, unlimited visibility, clear to scattered clouds,* and no forecast or reports of any turbulence. A beautiful day for the flight. He took off in the Cessna at 2 p.m. and for the next hour and a half he enjoyed a relaxed and uneventful flight as he flew smoothly along toward Idaho Falls. He was cruising over the desert plateau at about four thousand feet, near the Craters of the Moon National Monument, when the unseen winds suddenly attacked him. The flight had been so smooth up to that point that the pilot later reported he had been flying with his feet stretched out over the right side and his head resting against the lefthand door. He admitted being fatigued, but said he did not fall asleep.

He was just over the Big Southern Butte, the largest of several buttes which rise out of the desert and lava bed terrain, when he was unexpectedly jolted by what he later described as violent turbulance. The nose of the Cessna pitched up, and the airplane rolled to almost an inverted position, as the pilot lost control.

The relaxed flight was over. The pilot got the airplane right side up and tried to level off, but by that time he was too low to avoid a crash. Luckily he managed to pancake down on a flat section of the desert floor. He broke off the landing gear, bent the prop, and cracked a wing, but he was able to avoid the rock outcrops. He climbed out of the airplane, shaken but uninjured, wondering what had hit him in that clear blue sky. He had to trudge several miles through the desert until he reached a house where he could call for assistance. The subsequent National Transportation Safety Board report states as the probably cause . . . "turbulence in flight, clear air." It was another case of a non-alert pilot who had been "ghosted" out of the blue.

An accident like this should not be dismissed as a freak occurence, a strange type of desert wind encountered in a flight far from home. Turbulence in clear air can happen anywhere and at any altitude, even right above an airport where you have just taken off in clear and windless weather. That is what happened to a 32-year-old businessman pilot who had just taken off in a Piper PA-11 from a private strip near Wapato, Washington. He was leaving on a business trip early that afternoon of July 20, and the flying conditions appeared perfect. It was a hot 95 degrees, but the sky was clear, the visibility unlimited. The pilot was experienced, with a total of 775 hours, 728 of them in type.

The takeoff in the little Piper tandem was smooth, and the pilot felt no cross winds of any kind. He got the airplane up to 300 feet AGL and was starting a medium bank left turn, when the turbulence hit him. Gusts of swirling air buffeted the airplane and raised the right wing to almost vertical—he began to sink in a nose-down attitude. He corrected his wings, bringing them slowly back to level, and he tried to get the nose up. But he was still sinking, and he later said he felt like he was flying behind his airplane with little control over

it. He just managed to get the nose level before he crash-landed in a potato field.

The pilot stepped out uninjured, but the airplane was a wreck: the gear was broken off, both wing tips were off, the propeller was bent, and there was extensive damage to the fuelage. That unexpected turbulence in clear air had knocked the Piper out of the sky a short distance from the calm takeoff spot. The NTSB report indicated "loss of control, or over control."

What is turbulence in clear air, and what causes it? Turbulence is an "irregular motion of the air," characterized by gusts, or sudden surges of fastmoving air. In a turbulent situation, whirls or eddies of air strike the airplane, like sudden blasts, causing a series of abrupt jolts or bumps. These blasts come from any and all directions of the compass, from above or below, or from any angle.

Turbulence varies in intensity and frequency, and the usual way of describing it is in terms of gust velocity. Light turbulence is described as having a gust velocity of 5 to 20 feet per second; moderate is 20 to 35 feet per second; severe is 35 to 50 feet per second; and extreme is more than 50 feet per second.

Some turbulence extends over a very limited airspace of only a few hundred cubic yards; the pilot can run into those with no warning of any kind. Other turbulence may stretch over miles, and with these the pilot frequently will have some warning as he begins to feel the slight bouncing at the beginning of the turbulent area. Throughout a large area of turbulence the intensity may vary from spot to spot.

Each area of turbulence has its own lifespan, which is frequently related to the time day and the atmospheric conditions, but not in a predictable manner. In general, the "ghostly gusts" are daytime creatures, rarely present after dark.

What causes this sudden turbulence in clear air? There are three principal types of turbulence of concern to the general aviation pilot: *thermal* or *convection* turbulence, *mechanical* turbulence, and *wind shear* turbulence.

The first and most common type occurs when a given point on earth absorbs enough heat from the sun to disrupt the orderly flow of air above it. The result is upward flow of air, accompanied by a corresponding downward flow replacing the heated air. There may or may not be clouds present, depending on the moisture in the air. The unsuspecting pilot of a light plane may be suddenly thrust upward or down, and unless his responses are prompt and appropriate he may lose control of the airplane.

Convection turbulence is a more frequent phenomenon on warm summer afternoons, but it can happen at any time of year. Thermal currents are often topped by dense dome-shaped clouds (cumulus) and by large, towering clouds with anvil-like tops (cumulonimbus); experienced pilots know that they can get a bumpy flight beneath these clouds and a smooth one above them.

Mechanical turbulence occurs when air near the surface of the earth flows over an

(continued)

Above—on an otherwise smooth day winds blowing across hangars may result in turbulence over the runway. Below—approaching a mountain peak to leeward, aircraft may encounter unseen downdrafts several thousand feet above the crest, several miles from the mountain.

Invisible Cat *(continued)*

obstruction, which transforms it into a vastly complicated snarl of eddies similar to rapids in a swift mountain stream. Any obstruction, man-made or otherwise, can cause it: buildings, trees, houses, mountains, hills and valleys, uneven terrain. A number of conditions also influence the intensity of this type of clear air turbulence: the roughness of the terrain, the wind speed, and the stability of the air mass.

Any air which flows slowly over a fairly smooth surface, such as rolling hills, usually only causes mild turbulence within a few hundred feet of the ground, but when the wind increases or the obstructions are higher or more sharply defined, the turbulence can increase in intensity and altitude to the point of forming a hazard for takeoffs and approaches to land.

Mechanical turbulence is also created when the wind blows over high ridges, producing the so-called "mountain wave effect." The wind blowing up the windward slope is usually relatively smooth, but as it spills over the leeward side it sets up strong swirling downdrafts which "flow" for miles, similar to water cascading down a rough stream. In particularly high mountain areas, this wave may "crest" at a height of 20,000 feet, and it may flow "downstream" over a hundred miles. A pilot should always exercise extreme caution when flying near the leeward side of mountains, because if a strong and steady flow of air is joined by rising thermal currents he could be in for a rough ride indeed.

The final factor which contributes to turbulence in clear air is *wind shear*, a sudden change in wind speed or direction. This phenomenon happens in either a horizontal or vertical direction—or sometimes in both directions simultaneously—and it results in a churning of the air which, if it were visible, would look something like fresh-sheared wool. Many pilots think that wind shear occurs only at upper altitudes near the jetstream, but actually it can be found at any level and with no visual clues to its presence.

Thermal turbulence, mechanical turbulence and wind shear may act individually or in concert to suddenly throw a light plane pilot on his back on a perfectly clear, dry day.

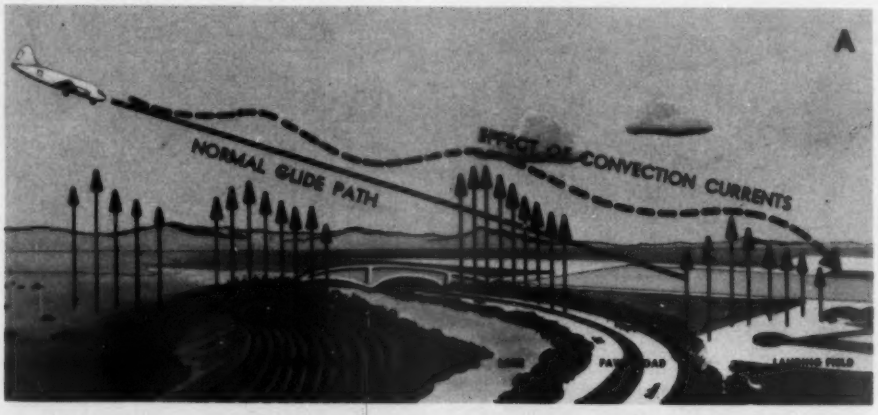
Is there any possible warning about turbulence in clear air? Weather forecasts do contain warnings about turbulence, but two things should be noted immediately about these forecasts. First, the symbol "CAT" when it appears in a forecast refers solely to clear air turbulence at high levels, 18,000 feet or over. Meteorologists define CAT as high level turbulence and that is the way the forecasts use it. It is not usually applicable to the general aviation pilot, unless he is flying a jet.

Second, the turbulence reports which do appear in the forecast depend more upon pilot reports which are radioed in than do the predictions of almost any other atmospheric condition. This means that the report of any turbulence aloft—whether it ranges from light to severe—often depends upon the evaluation of some other pilot, and what may seem moderate to one pilot may seem savage to another, especially if he is in a smaller airplane. Furthermore, a pilot who reports that he is experiencing light turbulence may only be at the edge of something bigger, and a half mile away it could be quite severe. In clear air, you cannot see the ghosts.

A pilot who is planning a flight will have to make some very careful go or no-go dicisions when he hears reports of turbulence ahead. *How severe it it? Will it affect his capacity to navigate safely?* And then he might have to think about his passengers, too. It might not be advisable to take a person up for a first flight in a turbulent condition. And it certainly would not be advisable to take a heart patient up, or young children, or nervous individuals. *How important is this flight?* After all considerations, it might be the day to read a good book.

The light plane pilot who encounters mild turbulence en route should prepare himself for possibly severe weather ahead —there is simply no way of knowing what the invisible spooks of wind are up to. Consider what happened to a pilot who ignored some early bumps in a flight in central California. Two men took off in a Luscombe 8A from Vacaville on a local flight to search for hunting locations. The weather was VFR—temperature in the 80's on that mid-September day, no precipitation, clear sky, visibility 15 miles. There was a 20 knot wind, though.

The pilot, 38 years old with 270 total hours, took off in mid-afternoon and flew north for about 20 miles while he and his companion scanned the area below for hunting locations. He then turned south and headed back toward the airport, but after a few miles he began to experience some bumps, a mild bit of turbulence. It was not serious, and he disregarded it. He was more interested in the area below, particularly some wooded territory on the east side of the mountain ridge, perhaps an ideal hunting spot. He went lower, flying with the ridge at 2,500 feet. The two hunters were about to become the hunted, and their stalker would be severe turbulence in the form of a downdraft.



Depending on the surrounding terrain, convective currents—localized vertical air movements—can cause either overshoot (above) or undershoot (below) during landing.

Abruptly, the Luscombe was caught by a leeward downdraft and driven down. The pilot fought for altitude, applying full power in an attempt to climb. But he still continued to go down. He had to make a quick decision. He felt there was not enough space to make a 180 degree turn without striking a wing tip and cartwheeling, so he decided to crash-land in the trees. He slowed the airplane as much as possible, and dropped it into the tops of some small saplings which absorbed much of the energy of the crash.

The two men were uninjured, even though the Luscombe was substantially damaged. The NTSB report, while citing turbulence as a factor, said the pilot exercised poor judgment in flying so low in that situation.

What should a pilot do if he finds himself unexpectedly in turbulence? The first and critical thing to do is get the air speed down to the maneuvering speed, which can be found on a placard or in the aircraft flight manual, but is not usually shown on the airspeed indicator. (Every pilot should memorize this number for every aircraft he flies.) Too much speed may cause structural damage or failure; too little speed may invite a stall even with the nose down, if the relative wind is from behind.

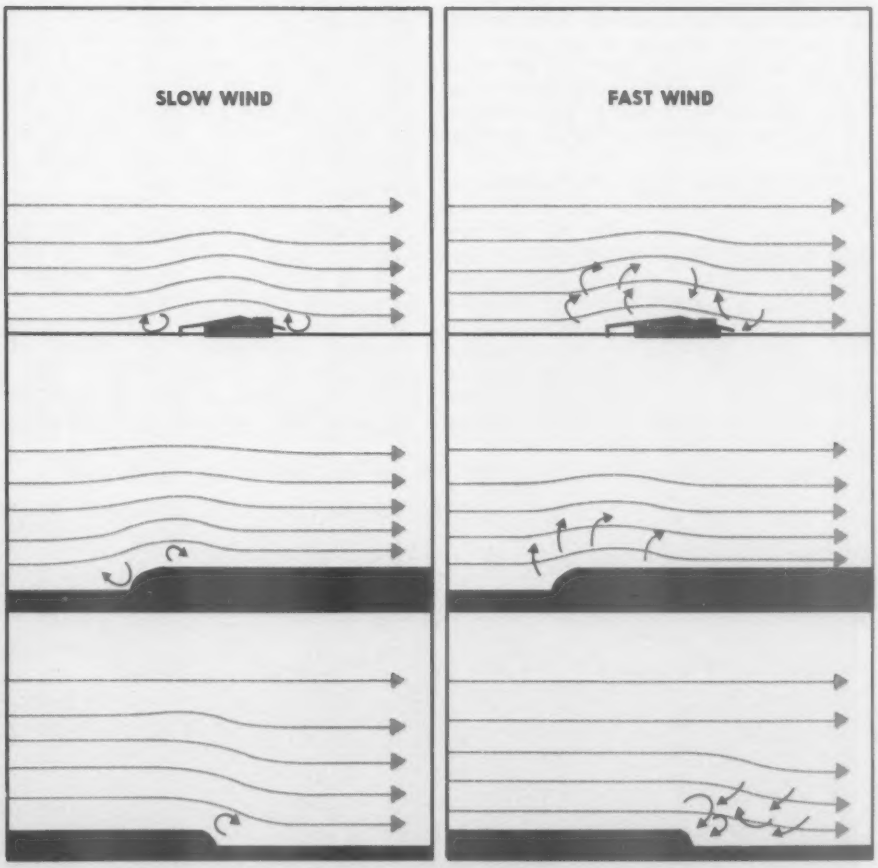
The pilot in turbulence should primarily fly *attitude*. He should not be particularly concerned about changes in altitude, as the airplane goes up and down in the turbulence, but should concentrate on keeping the nose near the horizon and the wing level. "Ride 'em loose," as if you were on a bucking bronco. Attempting to make too many fine altitude corrections can result in overcontrol.

Of course, if you are close to the ground when turbulence hits, you have to be concerned about that. If there is any hint of possible turbulence you should give yourself plenty of altitude, because you can never be certain whether the wind elevator is going up or down. Where there is a possibility of turbulence from mountain waves, for instance, it is good practice to fly at an altitude 50% greater than the height of the range where conditions permit. Consider what happened to a young pilot flying in Alaska when he got caught in a turbulence situation in clear air and did not have enough altitude to pull out of it.

The 28 year old pilot took off with his wife and young son on a sightseeing trip from Gulkana. He had 245 total hours, and 96 in the Cessna 172K he was flying that August day. Departure was late in the morning and the weather seemed fine—VFR, no precipitation, 30 mile visibility, and a few scattered clouds. They flew along the Denali Highway toward Paxton at an altitude of about 5,000 feet for about a half hour, until the pilot spotted some animal or bird on the highway which attracted his attention. He circled, and came down to 700 feet AGL and made a straight pass over it.

His flight path took him over a gulley, at which point he was hit with what he later called extreme turbulence—"The aircraft seemed to fall out of the sky!" The turbulence first lifted up the 172's nose, and then pushed the whole airplane downward. Apparently the gulley was acting as a natural Venturi tube, sucking air down through it. The pilot applied full power and lowered the nose, but he was too close to the ground to get the Cessna back in control and fly through the turbulence. He managed to level off with throttle back, landed hard and flipped over. The Cessna received substantial damage (over $6,000), but fortunately the family of three suffered only minor injuries. They were lucky.

Low level turbulence may vary daily, depending on terrain obstructions and wind velocities.



Sudden turbulence which occurs around airports in clear weather is not usually called "CAT" but for all practical purposes that is what it is. It might be called cross winds or gusts, but the same pattern prevails: clear, VFR weather, and then sudden turbulence which might range from light to severe. If it is experienced at a critical point during takeoff, aborting the takeoff may be indicated. Failure to react properly to turbulence over the runway is a frequent cause of takeoff accidents.

Similarly, turbulence experienced unexpectedly during the landing phase can also lead to trouble. The surprise element is really the key factor: the alert pilot who finds the nose thrust up suddenly or experiences a sudden loss of lift can correct the trim and power setting of his aircraft quickly enough to retain control. The pilot who hesitates, wondering "What is *that?*" may let the airplane stagger into an attitude from which it cannot be recovered at low altitude. There are only about a dozen accidents a year ascribed directly by NTSB to "turbulence in clear air," but there are hundreds more in which "unfavorable wind conditions," or "downdrafts/updrafts," or simply "adverse winds" are cited as a casual factor. What you cannot see can really hurt you.

The temptation to relax prematurely is always present at the end of a long or arduous flight, especially when the runway is clearly in view and everything seems to be very friendly. Don't you believe it, ***Keep on the alert.*** The gust goblins may get you if you don't watch out. ■

Famous
Flights

Salomon Andree, Swedish balloonist who with two companions in 1897 attempted the first flight to the North Pole.

ILL-FATED EAGLE

At Spitzbergen, far inside the Arctic Circle, an unexpectedly large crowd of 150 persons, including the crews of two Norwegian whalers and a Swedish gunboat, watched as three cutlasses simultaneously slashed through three tetherlines. Almost at once the high balloon was seen to emerge through the open roof of the "balloon house," and a few seconds later three gentlemen from Sweden were observed waving farewell in the wicker car suspended from the balloon. One of the most fantastically ambitious efforts in the history of aviation had begun: the first Polar flight.

The year was 1897, toward the close of a decade which had seen intense and internationally competitive Arctic exploration. It was natural, therefore, that when Salomon Andrée, an obscure Swedish engineer with some ballooning experience and much conviction, proposed to plant the blue and yellow colors of Sweden at the North Pole ahead of all others by means of a flight in a navigable balloon, he engendered enthusiastic support from his countrymen, from the most ignorant peasant to His Majesty King Oscar.

Who was this instant folk hero? Salomon August Andrée was the son of a small town druggist, Claes Andrée, who died when the boy was 17. He was extremely fond of his mother, and was never known to display affection to any other woman. One of seven children, Salomon gave no early sign of genius or unusual ability. He reacted strongly against any kind of military life. He also disliked art of all kinds, hated opera and looked down his nose at hobbies. He was said, in later years, to be the kind of man who would look at a painting only if it depicted some new mechanical invention. He was also described as having a "compulsive urge to live life the hard way," and he disclaimed any acquaintance with the emotion of fear.

After graduating from the Royal Institute of Technology in Stockholm in 1875, Andrée worked his way to America the following year to sample the technical wonders on display at the Centennial of American Independence in Philadelphia. There a chance acquaintanceship with John Wise, the leading American balloonist, gave shape to his dream of becoming the first man to reach the North Pole. Although he was obliged to return to Sweden shortly and take up his profession as a mechanical engineer, he managed to further his personal interests by participating in and studying polar expeditions, on the one hand, and continuing his development as a balloonist on the other.

His first ascent was made with a Norwegian aviator in 1892, and the ensuing publicity encouraged a Swedish newspaper to finance his construction of his own balloon, the *Svea*. Soon he was making solo flights, landing as far away as northern Finland. In 1895 he presented to the Swedish Academy of Science a plan for flying over the North Pole in a "navigable balloon."

The plan might have been dismissed as a mad dream had it come from anyone other than this "most practical of men," who was then in fact Chief Engineer of the Swedish Patent Office. Balloons, as any school boy knew, traveled at the mercy of the winds, which are wild and unpredictable at the Pole. How could he steer it? How could he survive the cold? Where would the flight end?

Chief Engineer Andrée had answers for everyone. The balloon he had in mind was a hydrogen-filled bag nearly 100 feet from top to bottom, made of mutli-ply pongee silk and varnished inside and out, against gas seepage. The "car" was a wicker basket large enough to contain bunks for the three-man crew, and decked over against the elements. The deck would also serve as an operations platform, or "bridge." Between the car and the bag Andrée planned to carry all manner of survival equipment, including three sledges, a canvas boat, tents, provisions, ballast, etc. Other supplies were to be stored inside the car, enough to sustain the crew for two years.

To navigate the balloon, three sails would be attached to a horizontal spar rigged between the car and the hydrogen bag. Tacking against the wind would be accomplished in the manner of a sailboat, with three lengthy (over 1,000 yards long) manila drag lines offering lateral resistance, like a centerboard or keel, as they dragged over the ice below.

To every objection, Andrée had an ingenious response, including a solution to the problem of providing hot food for the Polar adventurers without igniting their hydrogen. An alcohol stove would be suspended some 25 feet below the car, with mirrors positioned to reflect the progress of the chef's efforts.

Although generally regarded outside of Scandinavia as sheer folly, Andree's proposal was endorsed by the Swedish Academy of Science and soon given financial backing. As crew he selected Nils Strindberg, 24, nephew of the famous writer, a professional photographer; and Knut Fraenkel 26, a mountain climber and amateur balloonist. Andree was 45.

On May 18, 1897, Andrée and his crew sailed for Sptizbergen, a land mass in the Arctic Sea about 750 miles south of the North Pole. There his balloon was inflated inside a specially constructed balloon house, open at the top but strongly built to withstand Arctic gales. For more than a month the balloon, "Ornen" (the "Eagle"), was kept fully inflated while Andrée waited impatiently for a southerly wind.

As midsummer passed without a favoring windshift, and the endless summer days began to shorten, tension grew. The prospect of returning to Sweden without a hero's welcome, to be laughed at in the streets, was unappealing to Strindberg and Fraenkel, unacceptable to Andrée. Abruptly, on the morning of July 11th, a strong wind sprang up from the south, and the entire camp was galvanized into action.

The "Eagle" was equipped with drag lines and sails for "tacking" against the wind.

On their polar flight Strindberg, Andree and Fraenkel carried provisions for two years.

The balloon rose out of its housing in splendid form, but after a brief ascent it began to lose altitude swiftly, either as the result of a downdraft or possibly because of fouling of the draglines. At any rate, the car bounced along the surface of the sea briefly and then the "Eagle" took flight again, rising to an altitude of about 1,600 feet. The three adventurers hardly had time to congratulate each other when they perceived that during the gyrations of the launch all three draglines had unscrewed themselves and dropped free—hence the sudden buoyancy. They no longer had any means of steering the balloon.

They were now at the mercy of the wind, which blew them first in a north-northeasterly direction, then westward toward Greenland, and then again toward the northeast. Optimistically they released carrier pigeons bearing the message—"All well." For nearly three days they struggled to take bearings and keep their fog-sodden and ice-encrusted balloon aloft. At times they bumped crazily along the ice surface of the sea, startling an occasional polar bear or seal, and at other times, when the clouds parted, they rose jerkily into the sky again. Gas leakage took place at a much faster rate than Andrée had anticipated, and eventually they ran out of every conceivable disposable weight. On the morning of July 14, they landed on the ice and deflated the bag. The "Eagle" was dead.

Their log indicated they had reached a latitude of 82° 55′ N, or about 490 miles south of the Pole. The vastness of the frozen Arctic Ocean precluded any chance of a rescue expedition locating them. It was nearly 250 miles to Spitzbergen. They packed their gear into the sledges and headed south.

They dragged themselves over 200 miles of rough ice, until their strength was gone. Strindberg died, apparently on October 17, and was buried by his two companions, who succumbed a few days later. Fraenkel died in his sleeping bag. The indomitable Salomon Andrée was found outdoors, leaning against a rock. Thirty years later a Norwegian sealing boat accidently came upon their final camp. The log of their hopeless flight and tortuous return was still legible enough to complete the record of the first aerial assault on a Pole. ■

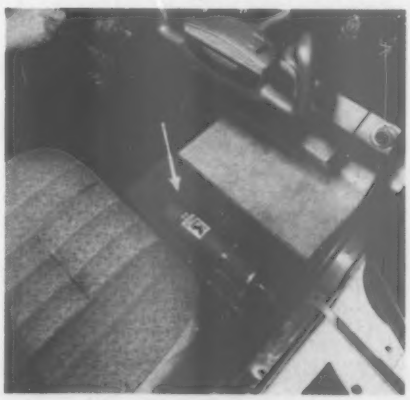
Pilot BRIEFS

■ EVERYTHING YOU WANTED TO KNOW ABOUT BAROMETRY. An updated FAA advisory circular offers guidelines for choosing and using barometers in the calibration and testing of aircraft atmospheric pressure instruments, including altimeters. Because of its role in collision avoidance and terrain clearance, accurate altimetry is viewed as vital in the efficient use of the airspace. Altimeter tests, prescribed by FAA rules, involves the use of a working standard barometer. AC 43-2A, "Minimum Barometry for Calibration and Test of Atmosphere Pressure Instruments" is available free from DOT/FAA Distribution Unit, TAD 443.1, Washington, D.C., 20590.

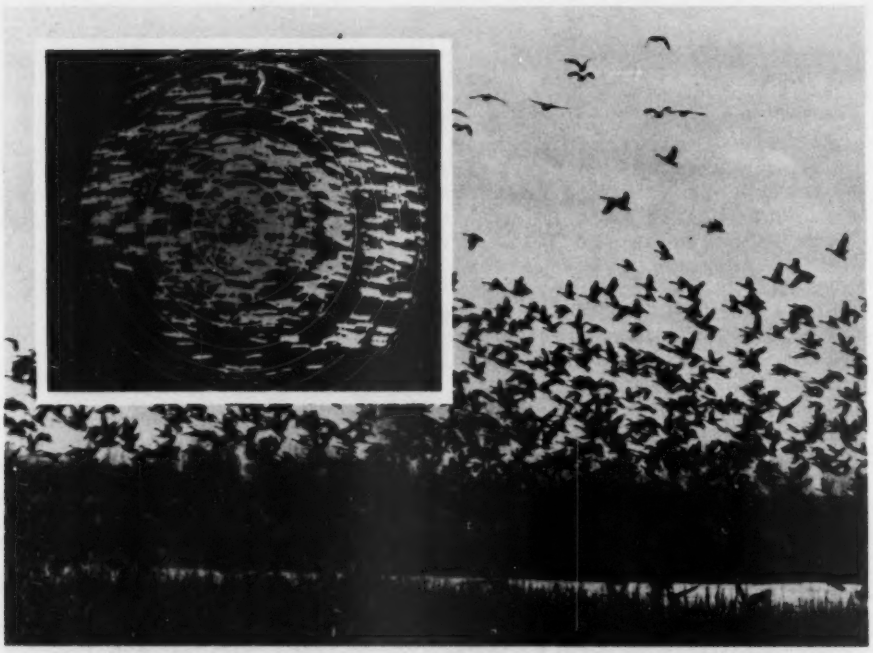
■ ONE FOR THE BIRDS. An experimental-exhibition DeHavilland, DHC-1B crashed shortly after takeoff recently when the engine failed. Accident investigators discovered that the pilot had forgotten to remove a rag stuffed into the air intake housing to prevent birds from building a nest inside. On takeoff the rag was sucked into the carburetor.

■ EXPEDITING THE HOMEBUILDING PROCESS. FAA is increasing the use of industry expertise to help minimize delays in the required progressive inspections and certifications of amateur-built aircraft. Qualified persons such as A & P mechanics, Experimental Aircraft Association (EAA) designees and others with experience in the design and fabrication of homebuilts may be called on to assist in conducting such inspections, under the supervision of FAA inspectors, whose availability is limited by their workload of high priority safety functions. Interest in amateur built aircraft in this country is rapidly increasing.

■ BOTTLE BLOW-UPS. It is a good idea to have a fire extinguisher on board your aircraft, but be sure it is a type suitable for the purpose and be sure also that it is mounted in a proper location. This caution follows some recent reports of mishaps involving fire extinguishers. In one case a portable fire extinguisher exploded while the plane was parked on a ramp in 90+ degrees in the sun. In a second case the extinguisher bottle was inadvertently replaced in a reversed position in the bracket, which was near a heater outlet. In flight, with the aircraft heater "on," the pressure indicator in the bottle "pegged out" and the extinguisher went off. In yet another instance a dry chemical extinguisher on board a plane flying at 14,000 feet exploded and contaminated the cabin with chemical. To determine if a given fire extinguisher is suitable for aircraft use, check with your FAA General Aviation District Office.



■ OKEFENOKEE REPORTING SERVICE has been inaugurated by FAA to help protect pilots flying over the foreboding swamplands of southeast Georgia. A pilot (who need not be on VFR flight plan) can request this optional service by radio from Alma, Brunswick or Jacksonville flight service station. He then reports in to FSS at regular intervals. Search and rescue is initiated after 15 minutes with no radio contact from the pilot.



FOWL TRAFFIC. On specially adjusted radar scopes, flights of birds can appear as bright pips. In fact, large flocks of birds can produce so much signal clutter on the radar scope that images of aircraft are obscured. Bird/aircraft collisions in flight can cause shattered windshields, failure of jet engines, and result in tragic fatal accidents. By locating and identifying bird flight patterns, radar can help prevent such accidents. During the fall season of bird migration pilots are advised to be alert and avoid areas where large numbers of birds are reported. Aircraft landing lights seem to help birds see and avoid aircraft.

"Ground Assist" Discloses Few Serious Deficiencies

Almost 55,000 general aviation pilots and about 8,000 mechanics were contracted during "Operation Ground Assist," the month-long FAA aviation safety campaign that ended on July 15. In addition, more than 28,000 aircraft were inspected. Considering the magnitude of the program, suprisingly few deficiencies were uncovered, and most of those were of a minor nature that were corrected on the spot. These deficiencies affected 1,480 pilots, 163 mechanics and 2,438 aircraft.

During the program FAA inspectors visited airports throughout the nation, concentrating on those serving large numbers of private aircraft, recreational areas and fly-in events. FAA Administrator Alexander Butterfield advised pilots in advance by letter that the aim of the program was to increase the level of safety awareness among pilots, flight instructors, mechanics, airport managers and others concerned with general aviation. He also solicited comments and suggestions on general aviation safety. Constructive recommendations included: "More spin training is needed." "Weather flying should be stressed more." "Initial checkout in a new type aircraft should be more stringent." "Safety checks should run year-round."

Numerous industry advisory groups, accident prevention counselors and flying organizations cooperated with FAA in "Operation Ground Assist" and all agreed it was a highly worthwhile program that should be repeated or continued throughout the year.

Terrain Warning Device for Jets

A rule has been proposed by FAA that would require an airborne "ground proximity warning system" for all large jet airplanes operated by airlines, air travel clubs and air taxi operators. The equipment would automatically provide visual and aural warnings whenever the plane descended to within 3,000 feet of the ground. There have been a number of air carrier accidents in recent years caused by the pilot inadvertently flying into the ground. The proposed rule aims to prevent such accidents in the future.

Comments to the proposal (#74-32) should be sent in duplicate to FAA, AGC-24, Washington, D.C., 20591. Deadline for comments is November 16, 1974.

FAA Written Exam Policy Clarified

FAA has clarified its policy concerning the use of flight planning aids such as computers, plotters, etc., by airmen applicants taking written examinations. Information printed on the device, other than instructions for its use, is disallowed and must be blocked off with masking tape or by some other means during the taking of the test.

Many flight planning tools now on the market contain aviation data on subjects such as regulations, signals, clouds, ATC procedures and patterns, frequencies, weight and balance. Because these subjects may be covered by test questions, this type of information is not permitted for reference during a written examination. Allowable aids include plotters, navigation computers, scales, straightedges, protractors and electronic or mechanical calculators. Advisory Circular AC 60-11, "Aids Authorized for Use By Airmen Written Test Applicants" is available free from DOT/FAA Distribution Unit, TAD 443.1, Washington, D.C., 20590.

FLIGHT INSTRUCTOR REFRESHER COURSES

Date;	Location:	Sponsor:
11/5-6-7, 1974	McAllen, Tex.	Texas Aero. Comm.
11/5-6-7	San Diego, Calif.	AOPA & San Diego 99's
11/12-13-14	Oshkosh, Wis.	Wis. DOT, Div. of Aero.
11/12-13-14	Baltimore, Md.	AOPA & Md. State Avia. Comm.
11/19-20-21	Spokane, Wash.	Wash. State Aero. Comm.
11/19-20-21	Callaway Gardens, Ga.	AOPA & Georgia Dept. of Avia.
11/25-26-27	Honolulu	Hawaii DOT
12/3-4-5	Jackson, Miss.	Miss. Aero Comm.
12/3-4-5	Fresno, Calif.	AOPA & Fresno 99's
12/10-11-12	Daytona Beach, Fla.	AOPA & Embry Riddle Aero. U.
12/10-11-12	Lincoln, Neb.	AOPA & Neb. Dept. of Aero.
12/17-18-19	Chicago, Ill.	Ill. Dept. of Avia.
12/17-18-19	Grand Forks, N. D.	N. D. Dept. of Avia.
1/7-8-9, 1975	Wichita, Kans.	Civil Air Patrol
1/11-12-13	Charlotte, N. C.	AOPA
1/14-15-16	Seattle, Wash.	Wash. State Aero. Comm.
1/14-15-16	Rochester, N. Y.	AOPA & NAFI
1/18-19-20	Portland, Ore.	Ore. State Dept. of Aero.
1/18-19-20	Long, Island, N. Y.	Civil Air Patrol
1/21-22-23	San Antonio, Tex.	Tex. Aero. Comm.
1/28-29-30	Knoxville, Tenn.	Tenn. Dept. of Aero.

Please contact sponsor or local GADO to confirm exact dates and locations. Note that some courses are scheduled for weekends.

• For Sale: A Piece of History

I was most interested in your September article on the 1924 round-the-world flight of the Douglas World Cruisers. Readers may be interested to know that the *Chicago*, flagship of the flight, is the subject of the first of the Historic Aviation Series of posters being produced by the National Air and Space Museum.

The 15 x 20 inch poster, suitable for framing, has a photograph of the *Chicago* with her sister ships, and contains a two-inch square patch of the original fabric of the aircraft The plane was re-covered recently in readying it for display in the new National Air and Space Museum. Matching posters of other historic aircraft, all with authentic fabric squares, will be issued from time to time.

The posters sell for $10.00 each and can be ordered, while supplies last, from:

Historic Aviation Series
National Air and Space Museum, Rm 1168
Smithsonian Institution
Washington, D.C. 20560

Clyde Brooks
Washington, D.C.

• The Sectional Blues

I sympathize with your reader who complained he could not read his sectional chart. I have the same problem. My new San Francisco sectional uses a light blue green ink for printing. Such vital information as airport elevations and runway lengths can very easily be misread. I am not against changes to keep costs down—but not if utility is sacrificed.

I wonder also if FAA would consider changing the symbol for non-tower airports which could show the traffic pattern direction for arriving aircraft. This could add information without increasing the printing expense.

Bernard Shoopak
Sunnyvale, Calif.

We have forwarded your comments regarding printing and color to the producer and publisher of aeronautical charts, National Ocean Survey (NOS).

Changing symbols for non-tower airports, plus an indication of traffic pattern direction, has been considered for some time. FAA presently has a change in the mill that would use blue color for airports with a tower, and red or magenta color for airports without a tower. Traffic pattern direction would be shown by using small angles on either side of the airport symbol. A final decision must await the outcome of a Notice of Proposed Rule Making that would standardize traffic patterns at most non-tower airports. This proposal is presently undergoing re-evaluation following public comments.

• Infusion De-confusion

Your article in the July issue on "Inflight Infusion" does not fully explain the physics of the situation. The problem is that when the atmospheric pressure is lowered (as when climbing to altitude in an unpressurized aircraft), water boils at a lower temperature than at sea level. If the boiling point is lower than that of the fluid temperature in the bottle being opened, a portion of the fluid will immediately flash into steam, pushing a mixture of steam and boiling fluid out of the thermos (and all over everything). For each degree of temperature that the stored fluid is above the theoretical boiling point, there will be a volume of steam equal to more than twice the volume of fluid.

At 11,000 feet, as in your example, the boiling point of water is 193°F. If the fluid in the thermos was 198°F or more (quite likely since it was probably near 212° at the time of filling), then there would have been at least ten quarts of steam for each quart of coffee. That is a lot of steam, hence the veritable explosion. Had the coffee cooled to 193°F or less, there would have been no spill. The air space left over the fluid had absolutely nothing to do with it and there is no comparable hazard with cold fluids.

The following table shows the maximum safe temperature for fluids in thermos flasks in unpressurized aircraft. A 2°F safety margin is provided for days of low barometric pressure.

"Uncorking" Altitude.	Safe "Uncorking" Temperature.
2,000′	207°F
3,000′	205°F
4,000′	203°F
5,000′	201°F
6,000′	199°F
7,000′	198°F
8,000′	196°F
9,000′	194°F
10,000′	192°F
11,000′	191°F
12,000′	189°F
13,000′	187°F
14,000′	185°F
15,000′	183°F
16,000′	181°F

Edwin M. Talbot, Jr.
Towson, Md.

Lowering of the boiling point is probably the most significant hazard possibility with regard to carrying liquids in sealed containers in unpressurized aircraft. However, seepage does occur at altitude with cold fluids when the cabin air pressure is less than the pressure in the container. The nature of such hazards depends on the kind of fluid and its location in the airplane. Also, cold liquids bottled under pressure, such as soft drinks, may "geyser out" when opened at altitude—certainly a potential hazard under some conditions of flight.

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

• Slow Flight vs. Min. Speed

I have about the same flying experience as the writer of your August article, "Come Fly With Me"—700 hours and a commerical certificate—but I have about 260 hours in *Cherokees*, half in a 180 model. Your writer's description of slow flight was to "maintain altitude as I slowed to 100 mph, then 90 and finally to 80, with flaps." This is hardly what one could describe as slow flight. I recall that I could slow-fly the *Cherokee* at an indicated 55-60 mph with full flaps and considerable power and still maintain altitude and reasonable control, although the controls are sloppy as they should be in true slow flight.

Too bad your writer didn't more thoroughly read the owner's manual. He (or she) mentioned the operator's handbook said to use carburetor heat, "as needed." The books I read said not to use it unless icing conditions were encountered.

Incidentally, thanks for the "punch-up"—I am going to take my beinnial flight review this month.

John R. McClure
Bellefontaine, Ohio

The exact wording in the owner's handbook is, "Carburetor heat should not be applied unless there is an indication of carburetor icing."

Regarding slow flight, FAA's Flight Training Handbook (AC 61-21) states, "Slow flight instruction should cover two distinct flight situations: the establishment and maintenance of the airspeed appropriate for traffic patterns and landing approaches in the airplane used; and flight at the slowest airspeed at which the airplane is capable of continued controlled flight without indications of a stall." Either kind (or both) may be called for in a flight review.

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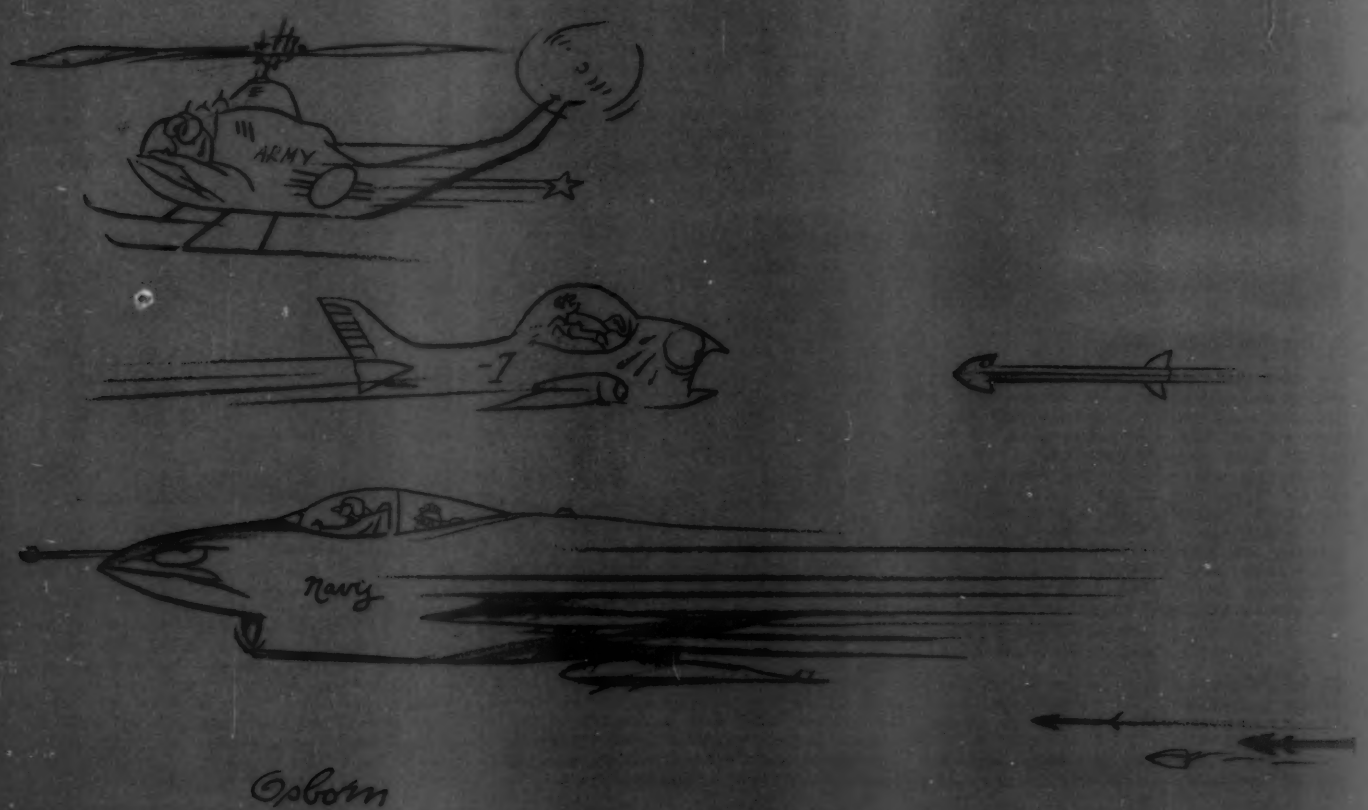

For everyone . . . including you

Suggested by Annabelle Ni
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